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INTERNATIONAL BULLETIN OF PLANT PROTECTION

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DAMAGE APPARENTLY CAUSED BY *SCLEROTINIA* OBSERVED ON SALAD CROPS IN ITALY *

In the spring of 1942, the Institute for Foreign Trade called attention to several serious facts which, affecting salad crops on the Adriatic littoral the previous year, had re-occurred with greater intensity. The severity of the damage had led Dr. L. ZANOTTI, at the time Chief of the Inspectorate of the aforesaid Institute for the Adriatic zone of central and southern Italy, to request the presence of an expert, as the greater part of the salad crops of the varieties 'Incappucciata riccia' and 'Trocadero' showed a peculiar rot of the tap-root which, in some cases, had completely endangered the commercial value of the crop. Moreover, it was found that some consignments of salads, apparently in excellent condition at the time of inspection, had arrived at their destination abroad in a severe state of rot.

Partaking myself there, and more precisely in the environs of Barletta, Francavilla a Mare and Pescara, I found how observation *in situ* of the plants enabled reconstituting the progress of the disorder in its various stages, such as they occurred in the aerial part of the plant. Just slightly affected plants, that is, at an initial degree of the disorder, presented, a more or less pronounced yellowing of the outer leaves which, subsequently, abandoned their erect position, and bent over until they reached the ground.

At a later stage, shrivelling of these outside leaves and a progressive yellowing, accompanied by a loss of turgidity of the leaves which still formed the head of the plant was noted.

Subsequently, all the aerial part of the plant withered, generally without any apparent sign of rot. In the cases when this occurred, on the contrary, then the development, among the rotting leaves, of an abundant white, downy mycelium, in the mass of which the sclerotia were distinguished, could be observed. In other cases, on the basal leaves of the shrivelled plants, a grey mould was found.

To these various manifestations on the aerial part naturally corresponded changes in the subterranean part of the plant and these were particularly localized in the tap-root, around the collar.

* Communication from Prof. ANTONIO BIRAGHI, Sub-Director of the Royal Station of Plant Pathology, Rome, Italy.

Such changes, consisting in a soft rot, began to become apparent when, in the aerial part, the basal leaves had already shrivelled. In the subsequent stages, rotting of the tap-root, started around the collar, spread towards the tip and transformed the root into a completely disorganized mass, having lost all consistency, condition which in consequence caused the immediate separation of the aerial part as soon as an attempt was made to uproot the plant.

Examination of plants, both of the tap-root and the affected aerial part, during these advanced stages, showed the presence inside and outside the tissues of a large mycelium possibly resembling a *Sclerotinia* and examination of cultures obtained by isolations derived from samples taken, in fact, enabled the fungus to be identified as *Scl. sclerotiorum* (Lib.) Massee of which, on the shrivelled leaves, sometimes the conidial stage (*Botrytis vulgaris* Fr.) developed, as a grey-brown mould. Less frequently, *Scl. minor* Jagg. was also isolated, but the symptoms presented by the diseased plants were identical in every case.

This collar rot of salad plants appeared for the first time in 1941, and in 1942 it returned with a much greater intensity, to such an extent that all the crops of the Adriatic region suffered very severe losses.

The unexpected appearance of this disease in a zone which, seeing its remarkable expanse, could not present everywhere the factors (nature of the terrain, type of fertilizer, moisture, etc.) generally considered as favourable to the virulent infection of *Scl. sclerotiorum* and allied species, did not allow of the principal cause of the damage suffered by the crops being attributed exclusively to a general and widespread infection of *Scl. sclerotiorum*. An element which added to this perplexity was the manner in which the diseased plants were distributed among the crops. Generally, the disease was not found to spread in a more or less concentric manner in one or several points of the field, but the affected plants were scattered, sometimes in small groups, but sometimes isolated amidst healthy plants. Evidently, the manner in which the rot occurred was not that usually found as in the case of a particularly virulent parasitic attack, in which the parasites spread from plant to plant through the soil.

In fact, on examining the plants during the early stages of attack, namely, when the aerial part only shows the onset of withering or yellowing of the first basal leaves, it may be noted that, on no part of its organs, neither on the leaves nor on the tap-root, are there any traces of rot or mycelium in the tissues. On cutting a section of the tap-root at the collar or even lower down, however, small and localized or larger and scattered spots, yellowish brown or purplish red in colour can be seen; the latter colour is characteristic of the 'Trocadero' variety.

Microscopic examination of sections of the tap-root cut at the level of these spots show that the abnormal colour is centred in some of the conducting bundles the elements of which present swollen and darkened walls, with the lumen full of gum. The bundles which show these modifications most frequently are the most central ones, that is to say, those which are formed first. Besides these facts, I was able to observe, in the medullary parenchyma of the tap-root the presence of schizogenous lacunae, the margins of which were darkened by gum deposit. Numerous attempts at isolating — over fifty — the eventual organisms present in

these modified tissues were made by inoculating small portions of tissue on suitable nutrient media ; however, the development of colonies of *Sclerotinia* was never obtained ; in most cases, the inoculations remained sterile, while in others, common organisms, practically all bacterial, developed.

The characteristics presented by the affected bundles of the tap-root and by the lacunae in the medullary parenchyma are such that it may be affirmed that these modifications are produced in consequence of falls in temperature occurring when the plants are still in the young state.

On the other hand, the ever negative result of attempts at isolating any eventual organisms present in these modified tissues exclude absolutely that the phenomena might be due to parasitic action.

The changes produced by cold in part of the conducting tissue only affected the plants when, with the coming of spring, namely, with the rise in environmental temperature, the water requirements of the aerial part increased in consequence of greater loss in moisture caused through transpiration ; the functional conditions of the conducting tissue, weakened through the degeneration of part of this tissue, do not allow then of regular and adequate transport of water from the roots to the green part.

The result of this general state of suffering of the plants, reducing their powers of resistance, was that organisms like *Sclerotinia*, usually considered as being present in practically all soils in a quasi-saprophytic state, gained the upper hand, attacking the plants and rapidly causing rotting.

From the facts obtained, therefore, I may affirm that the primary factor which determined the damage suffered by salad crops on the Adriatic versant were caused through the exceptional rigorous winter of 1941 and, to an even more appreciable extent, that of 1942.

The irregular distribution of the diseased plants is due to the fact that, in the same field, the plants are at different stages of growth, since the plants which are eventually missing are gradually replaced as they disappear.

The secondary nature of the infection thus being established, all search for direct means of controlling the *Sclerotinia* naturally become useless ; moreover, this method of control is practically impossible in the case of crops grown on a large scale ; but the measures to be taken in order to prevent serious losses recurring in salad crops should all be directed towards finding some rootstock of the varieties at present cultivated which show a special resistance to cold.

Another element which should be taken into consideration is that the crops in question should be helped to acquire a greater degree of resistance to cold, either by applying a good potassic fertilizer, or by limiting, at least during the period which precedes a possible fall in temperature, the use of nitrogenous fertilizers.

The presumable effects which may be obtained on modifying fertilizer applications according to the criteria indicated certainly cannot completely solve the question, because the use of these modifications cannot tend solely towards increasing the resistance of the plants to cold without taking into account the influence of the fertilizers on the quality characteristics of the product, characteristics which have to correspond to commercial requirements.

Since it is a question of damage caused through cold which is localized in the subterranean part of the plant, it would be interesting to attempt direct protection of the tap-root by covering the ground with an insulating material, for instance, wheat chaff or straw, which prevents unexpected cooling of the surface layers of the soil. It is probable that, by this means, the aim in view could be attained with a greater chance of success than by employing special fertilizer formulae. From the standpoint of an eventual practical application, this system would present an even greater simplicity and would give everywhere the same results, since the inevitable disturbances which would arise from the use of special percentages of fertilizers on soils of different types and composition, would be eliminated.

An experiment plan was drawn up for the year 1943 with Dr. ZANOTTI; owing to the difficulties caused through war conditions, however, experiments could only be carried out on the experiment fields and not on the sowings, also fertilizers could only be applied during the period between January 30 and February 12, since it was not possible to have in time the qualities and quantities of fertilizer necessary.

There were three experiment fields: one in the region of Monopoli, one in that of Molfetta and the third in the Bisceglie region; they were prepared and inspected by Drs ZANOTTI and PIRISI as well as by Mr MARIANI, agricultural expert, who dealt with the statistical data, both during the growth period of the plants and at the time of harvesting.

The results obtained in the three fields did not in any way agree insofar as regards percentage of plants attacked by rot, and it was concluded that the different combinations of fertilizers employed * had not had any effect on the factors which determine rotting.

These entirely negative results, however, were not completely unexpected, since the data collected following the study of the salad plants, as well as that which I have already previously explained, show that the causes which predispose the plants to rot attack occur during the first period of growth.

The conclusions relative to the predisposing cause of rotting to which I had come following examination of material collected in 1942 from crops of the Adriatic littoral were confirmed in consequence of the possibility offered me in 1943 to examine a very large number of salad plants, in all stages of decay, collar rot also occurring in the kitchen-garden of the experiment field of the Plant Pathology Station. Further, I had the possibility of visiting several fields of 'Trocadero' at Sezze in the Pontine Marshes region, and there also I found the same phenomena already described. Where the plants were not rationally spaced and, consequently some of them touched, I was able to observe that nearly always, if one of the plants was subject to rotting, the others, which, however, were in contact with the leaves invaded by *Sclerotinia*, remained perfectly healthy throughout the duration of the vegetative cycle.

* The salts employed were: - superphosphate, calcium nitrate, ammonium sulphate, cyanamide, potassium sulphate; they were employed alone or in different combinations in dose of 10 kg. or 4 kg. per 100 m². Moreover, the action of the fertilizers was delayed by the dry year as the first rains fell on March 6.

Having fixed my attention on this problem, I started to examine other species, of herbaceous plants, for example, in chicory crops at Sezze, growing near the 'Trocadero' crops, I observed, on cutting a section of the tap-root, the same type of modification due to sudden falls in temperature. In this case, the plants, according to the extent of the lesions caused in the conducting tissue of the tap-root, did not succumb to *Sclerotinia* attack, but showed phenomena of more or less intense wilting of the basal leaves and, at least, underwent an appreciable reduction in growth.

I was able to ascertain another similar case on bean plants sown in November and examined in the spring of 1943 at Maccarese. In the middle of the field, examples were seen here and there which showed a general wilting of an unforeseen nature. On examining the tissues at the base of the stem and of the tap-root, no trace was found of plant parasites (absence always confirmed by isolation for culture tests), nor of the action of animal organisms.

On the other hand, on cutting a section of the base of the stem and of the tap-root, the modifications in the conducting elements, already noted in the case of salad crops, was remarked.

If, instead of uprooting these plants they were left *in situ* for some days, at first a reddening of the epidermal tissues of the base of the stem were observed, then a darkening, and finally signs appeared indicating that probably micro-organisms had become established in the tissues. In fact examination made it possible to detect the presence of mycelium which on isolation gave rise, in most cases, to *Sclerotinia* or to other organisms presenting a decided saprophytic character. Naturally, after the intervention of one of these fungi, the plant yellowed and rapidly died off.

In this case also, expert histological examination carried out in the first stages when the plant was ailing led to the conclusion that the primary cause of the mortality of the plants was due to the injurious action of sudden changes in temperature which occurred when the plants were young; the presence of micro-organisms should be considered as quite a secondary fact.

All these observations agree with what I have already had the occasion to point out on various occasions, both for wheat * and for different fruit plants †.

In the cases described above, the functional deficiencies were verified in herbaceous plants which, being succulent, favoured the development in their tissues of organisms of weak parasitic action, the presence of which may dissimulate the primary and fundamental cause of the change suffered by the plant. It appears evident, therefore, that the histological examination and observation of specimens at the first stages of decay is absolutely indispensable for an accurate diagnosis.

* BIRAGHI [ANTONIO] Anomalie anatomiche ed alterazioni prodotte da freddi tardivi su piante di grano. *Bollettino della R. Stazione di Patologia vegetale* [di Roma], Firenze, 1938, anno XVIII, n.s., n. 4, pp. 471-496, figg. 1-17.

† BIRAGHI, [ANTONIO] Sulla presenza di cordoni endocellulari in mandorli danneggiati da freddo. *Bollettino della R. Stazione di Patologia vegetale* [di Roma], Firenze 1941, anno XXI, n.s. n. 2, pp. 101-116, figg. 1-7. Opere consultate, pp. 115-116.

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* Drawn up by GIULIO TRINCHIERI, International Institute of Agriculture.

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